



## Comparative Analysis

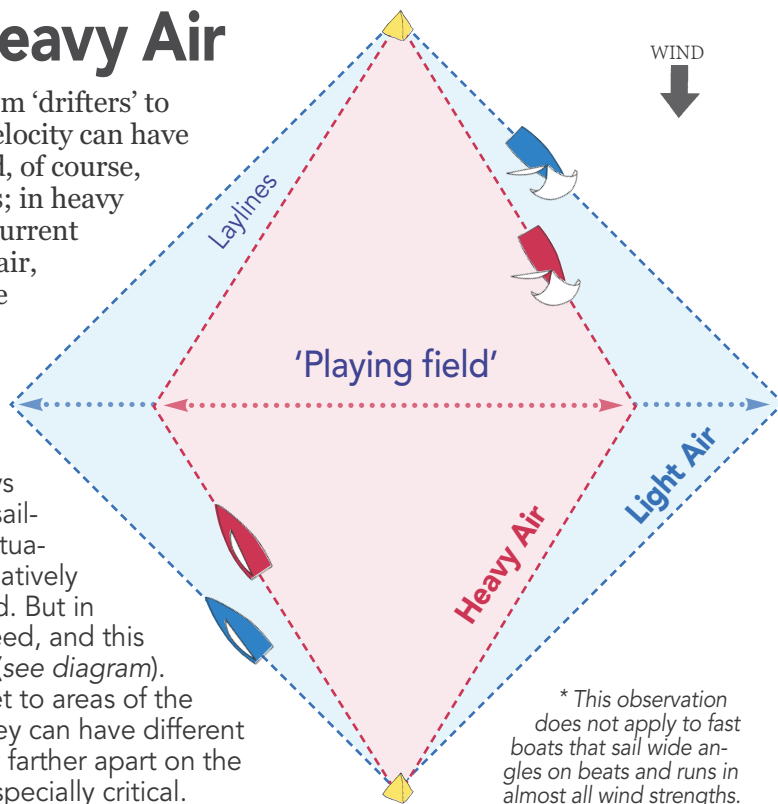
# Issue 137

# Light Air vs. Heavy Air

Sailors race in a wide range of wind strengths, from ‘drifters’ to ‘screamers,’ and we know the amount of wind velocity can have a huge impact on strategy, tactics, boathandling and, of course, speed set-up. In light air, we work hard to find puffs; in heavy air, shifts are relatively more valuable. In light air, current has a huge effect; in heavy air not as much. In light air, wind shadows are costly; in heavy air we can survive in them. That’s what this issue is all about – the need to change priorities in light versus heavy air.

## Impact of changes in the 'playing field'

Unlike a football field or basketball court, which always keep their same size and shape, the playing field for sailboat racing is constantly changing, due largely to fluctuations in wind velocity. In heavy air, many boats\* sail relatively narrow angles both upwind and (especially) downwind. But in light air they have to sail wider angles to maintain speed, and this takes them farther into the corners of beats and runs (see *diagram*). This has two implications for light air: 1) Boats may get to areas of the race course they don't see in breeze, which means they can have different current, geographic wind shifts, etc.; and 2) Boats get farther apart on the race course, which means strategic factors become especially critical.



\* This observation does not apply to fast boats that sail wide angles on beats and runs in almost all wind strengths.



**LIGHT AIR:** Focus on patience, the mental game, weight placement, smooth boathandling, powerful sail shapes, avoiding bad air, finding puffs and the effects of current.



**HEAVY AIR:** Focus on communication, anticipation, hiking hard, teamwork, playing the shifts, steering in waves, risk avoidance, flatter sail shapes and enjoying the ride!

**SPEED&Smarts™****Comparative Analysis****Light Air vs. Heavy Air**

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**Some things work in every wind velocity**

Racing in light air is usually very different from racing in heavy air, and that's what this issue is all about. But there are also many strategies and principles that apply in both light and heavy winds.

The need for twist in your sails is a good example. In simple terms, twist is the degree to which the leech of your main or jib falls away from a straight line. In moderate wind you can trim your sails very tightly with relatively little twist, which helps you point high.

In light air, however, you can't trim nearly so tight because the wind won't be able to stay attached, and the sail will stall. To prevent this, ease your sheets to let the sails twist. You also need more twist in heavy air, but for a different reason. If you trim the sails tightly they will have too much wind pressure in them, and the boat will be overpowered. So you have to ease the sheets a bit for more twist. Here are some other things that light and heavy air have in common.

**Good boatspeed wins in any condition!**

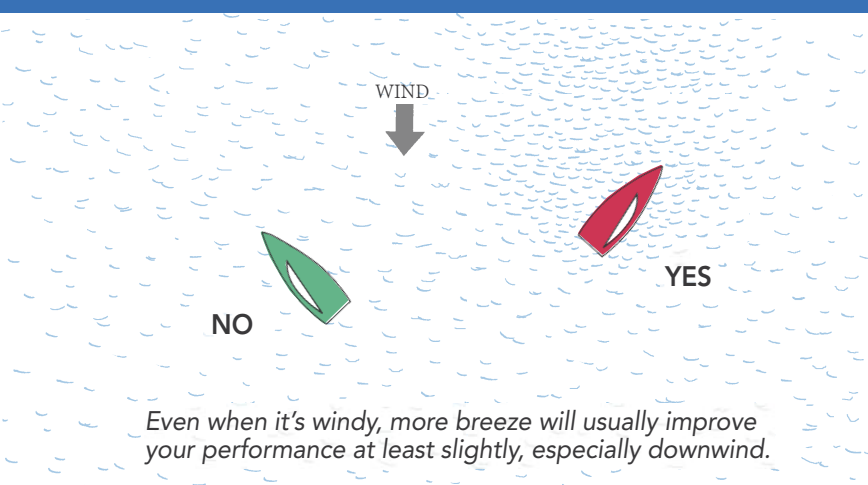
One thing common to light and heavy air is the value of good speed. Going fast is no guarantee of victory, of course, but it makes life a lot easier and will improve your chances of success. Here are two reasons why it's especially important to focus on speed in light and heavy air:

- 1) Making your boat go fast can be challenging when there's a lot of wind, or not much. Consistent speed requires constant effort; and
- 2) In light and heavy conditions you will find the widest range of boat-speed (from the slowest to the fastest boat) among the fleet. This means you'll have more opportunities to gain using speed than in moderate air when most of the fleet goes about the same speed.



When the wind velocity is in the moderate range between light and heavy, it's relatively easy to make most boats go fast. But speed is more elusive when there's not much wind at all, or tons of it. In these tricky conditions you need to line up with another boat to make sure your speed is OK. Plan to do this before the first race of the day (and whenever there has been a significant change in the wind or waves). Don't wait until you come off the starting line to learn whether your speed is good or not – by then it's too late! And don't call off practice sessions when you have light or heavy air. Those are exactly the times when you need to train – most sailors don't sail nearly enough in these conditions.





Even when it's windy, more breeze will usually improve your performance at least slightly, especially downwind.

## More wind is (almost) always better

It's obvious that finding more wind pressure is very valuable when you're sailing in light air, but more wind is better in almost any wind velocity. Wind helps a boat sail faster through the water, on a higher angle upwind and a lower angle downwind. Of course, the value of getting an additional knot of wind depends on how much wind you start with. If you're racing in 25 knots, for example, another knot or two of wind won't help very much. But it will make a huge difference when you are racing upwind or downwind in just 6 or 7 knots. (For much more on this subject, see pages 4 and 5.)

## Focus on boathandling

Another thing that light and heavy air have in common is boathandling challenges. It's easy to make good sets, takedowns, tacks and jibes when the wind is moderate. But when it's so light that filling your sails is difficult, or so heavy that the crew and boat are overpowered, that's a different story.

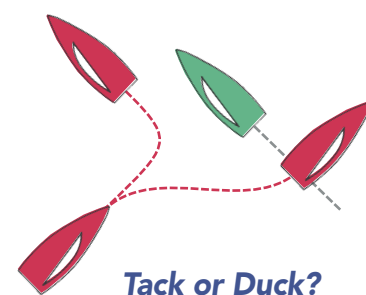
The best way to minimize this problem is by seeking out light and heavy wind to practice maneuvers. When racing in these conditions, 1) clearly define roles for all crew; 2) focus on good communication; and 3) allow plenty of time for each maneuver. One nice result of better boathandling is that you will have more strategic and tactical options.

## Choose strategy before tactics

Strategy is a plan you create for how to sail around the course as quickly as possible in the absence of other boats, while tactics are boat-on-boat moves you make to follow your strategy and stay in control of your race.

In all wind velocities, strategy should be your main priority, and tactics are used only when necessary to keep you on track (because every time you make a tactical move you lose distance to all other boats in the fleet).

In light and heavy air, it's especially important to have a clear strategic plan at all times. This is because maneuvers that require boathandling are costly in those conditions, so you want to make only the tactical moves that are very essential for your strategy.



## Tack or Duck?

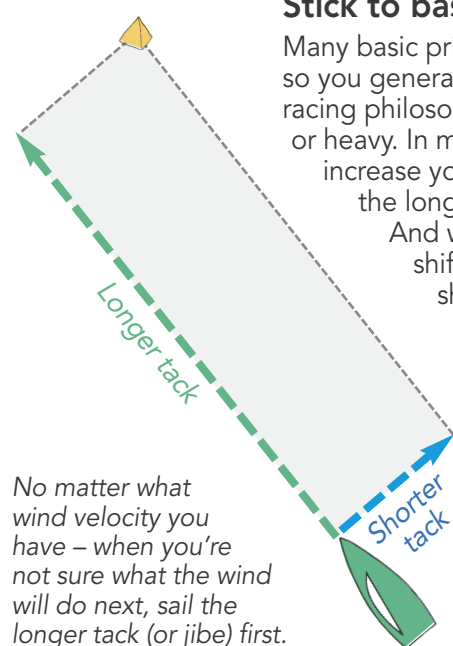
When racing upwind, a port tacker's decision of whether to tack or duck should always begin with the question, 'Which way do I want to go?' Think ahead and decide on a strategic plan first so you can use this to guide your tactical choices later. This applies no matter how much wind there is.

## Stick to basic rules of thumb

Many basic principles work in any wind velocity, so you generally don't need to change your racing philosophy just because the wind is light or heavy. In most cases, for example, you will increase your chances of success by sailing the longer tack or jibe first (see diagram).

And when you're racing upwind in a shifty breeze, sail toward the next shift you expect.

However, there are also rules of thumb that apply only to particular wind velocities. For example, in heavy air it's usually more valuable to sail for shifts rather than extra pressure, and in light air it's much more critical to avoid wind shadows than in heavy air. (For much more on these subjects, see pages 4 to 7.)



No matter what wind velocity you have – when you're not sure what the wind will do next, sail the longer tack (or jibe) first.

## When you need to maneuver, make sure you're at full speed

Most maneuvers are costly, so don't make them without a good reason. This is especially true when there's a lot of wind or not much wind. In light air, it's easy to lose momentum whenever you turn the boat, and it can take a long time to regain your speed. In heavy air, potential risks include crew errors and breakdowns.

When you need to make a maneuver, don't start it until you have decent speed. This applies in all wind velocities. In light air, for example, don't tack in a lull or just after you hit a bad wave. Make sure you are at full speed (or faster), then tack.

In heavy air, don't jibe when you're slow because there will be too much pressure in the sails. Wait until you are surfing fast down a wave and then make your turn – the sails will jibe much easier.

## The effect of wind velocity on strategic choices

In most races, two key strategic variables seem to have by far the biggest impact on boats' overall success (or failure). These are wind velocity (*'pressure'*) and changes in wind direction (*'shifts'*).

If you find the best pressure on the course and also play the shifts correctly, you'll be in great shape. But sometimes you can't do both at the same time. Often you must choose between sailing toward the best pressure or playing a wind shift correctly. Which is better?

In many 'puff-or-shift' situations, the better strategy depends on how much wind there is. In heavy air, you likely have plenty of power and are sailing almost as fast as the boat will go. In this case, another couple knots of wind will not improve your speed or height much. But sailing the lifted tack upwind (or the headed jibe downwind) will be very helpful getting to the next mark. Therefore, when it's breezy, a good rule of thumb is to play the shifts first and don't worry so much about the puffs.

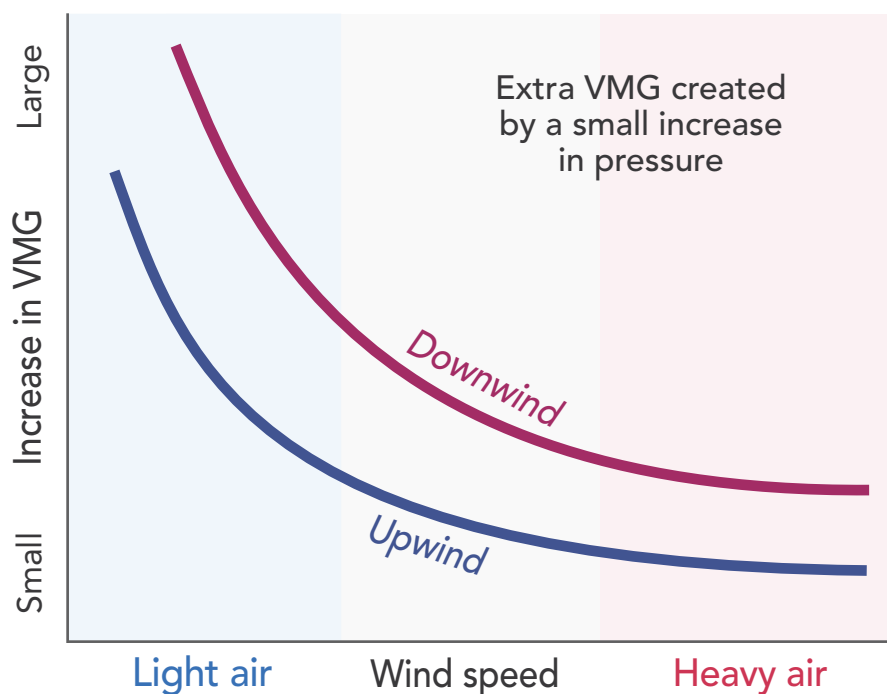
In light air the opposite is true. When you're sailing slowly, even a tiny increase in pressure can have a significant impact on your speed. If the average wind speed is seven knots, a two-knot puff represents a huge increase in power!

In addition to giving you better speed through the water, a puff is like a shift because it allows you to point higher upwind (and lower downwind). These are two great reasons why finding extra velocity should be your top priority when the wind is relatively light.

Shifts can also be valuable in light air, but a lift (or header on a run) without good pressure is not very helpful. Once it gets windy enough that more wind will not increase your speed or height very much, shifts are especially critical.



The windier it gets, the less critical it is to find more pressure. These Laser sailors, for example, are well-overpowered while sailing upwind in this breeze. Therefore, their strategic plan on this beat was likely to play the shifts correctly rather than look too hard for puffs. If this wind suddenly dropped to seven knots, their strategic priorities would be totally different.



### Assessing the value of extra wind velocity

Finding a small increase in pressure will help you much more in light air than it will in heavy air. When you already have enough wind to be fully powered up, a little more wind won't make you sail much faster or higher upwind, so it doesn't help your VMG (velocity-made-good) much. In light air, though, even a little more velocity can have a huge impact on your upwind speed! The same trend is true downwind, though a small increase in pressure will be slightly more beneficial for your VMG in all wind velocities.

## Five questions to ask

When you're trying to decide if you should head for a puff on the left side or sail a good shift toward the right, ask yourself these questions:

### Underpowered or overpowered?

When you're sailing upwind, are you constantly looking for more power, or do you have too much? If you are underpowered, finding more pressure will always be more valuable than if you are flogging your sails to keep the boat flat.

### Upwind or downwind?

As a general rule of thumb, shifts are more beneficial on beats while pressure is more valuable on runs, largely because 1) puffs stay with you longer downwind, and 2) puffs allow you to sail deeper downwind, so they are like shifts. But making a strategic choice also depends on wind velocity. The lighter the wind, the more you should lean toward finding more pressure, no matter what leg you're on (*see right*).

### How big is the puff or shift?

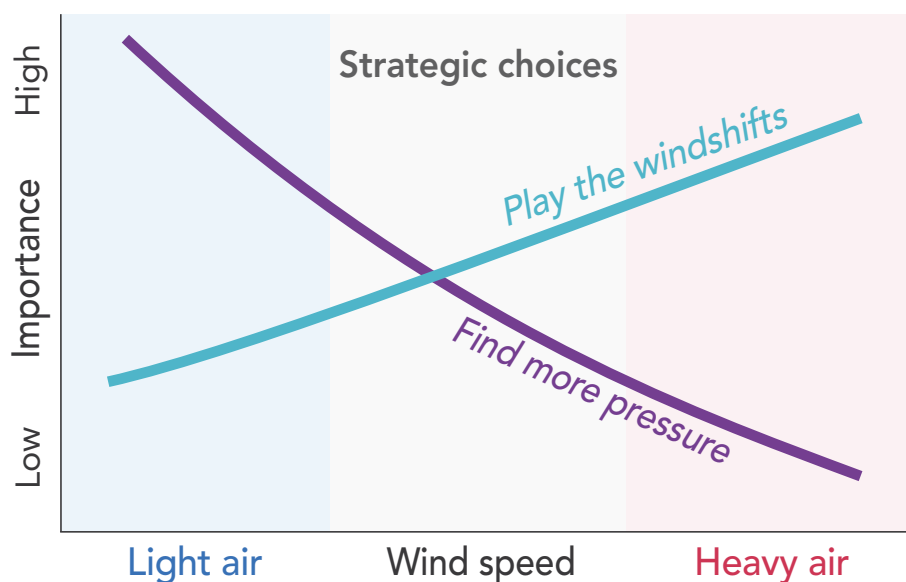
Any decision about pursuing a puff or shift depends on the size of the puff or shift, of course. Are you choosing between a 10° shift and a one-knot puff? Or a 2° shift and five more knots of pressure? And will the puff or shift last the rest of the leg, or just 30 seconds? Most strategic choices are not as simple as 'puff or shift.' They require good observation and assessment of a multitude of factors.

### What is the cost of playing the puff or shift?

Will you have to tack or jibe (once, or maybe twice) to pursue either strategy? The cost of boathandling varies with wind velocity (*see page 8*). If a maneuver costs you more than the amount you will gain by making it, then it's probably not the right move.

### Planing or surfing?

If you're sailing downwind, will a little extra pressure allow you to surf or plane? If so, you should almost always go for more wind.





## Determining strategic priorities in light and heavy air

ABOVE: Here's a simple graphic showing basic strategic priorities over a range of wind velocities (roughly covering both upwind and downwind). In light air, it's generally more important to find better pressure than look for windshifts, while in heavy air the opposite is usually true.

BELOW: Here's another way to visualize strategic choices, with upwind and downwind shown separately. When you're sailing downwind in light air, pressure is all-important. On a very subjective scale of 0 to 100, I would give pressure an 80 and finding shifts a 20. For upwind in light air, pressure is still key (70) but finding shifts is slightly more valuable (30).

In heavy air, the numbers are basically reversed. When you're sailing upwind, extra pressure won't improve your performance much so I give it a 20. That makes playing the shifts very important (80). On a run, more pressure will almost always improve speed, so this is a bit more valuable (40). But finding shifts is probably still the priority (60). Of course, we can tweak these numbers quite a bit depending on boat type and whether you are sailing at the low or high end of each wind range.

	LIGHT AIR	HEAVY AIR
 Upwind	70 <b>Pressure</b> Shifts 30	20 Pressure <b>Shifts</b> 80
 Downwind	80 <b>Pressure</b> Shifts 20	40 Pressure <b>Shifts</b> 60



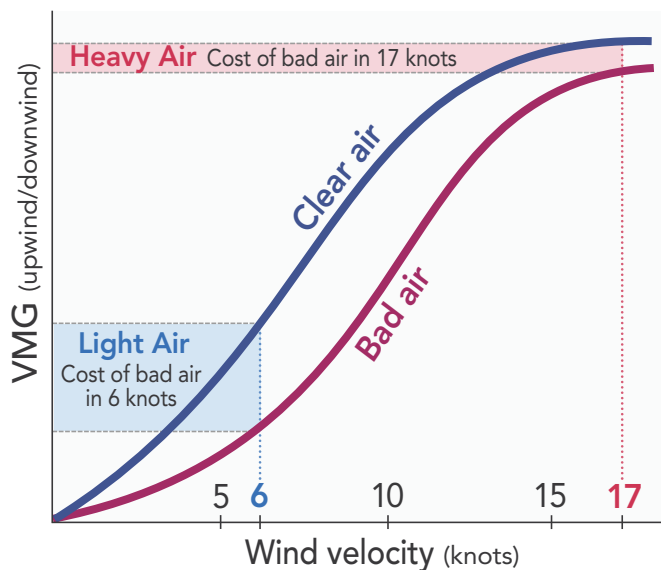
## The nature of wind shadows

When you're looking for speed on a beat or run, the more wind you have the faster you'll go. That's why sailors avoid the bad air of other boats.

The problem with sailing in wind shadows is that you have less wind velocity than boats sailing in clear air. This hurts in two ways. First, your boatspeed is slower through the water. And second, you'll have to sail lower (upwind) or higher (downwind) to maintain speed. Both are bad for VMG (velocity-made-good).

These problems are significantly worse when there's not much wind. In light air, wind shadows are a bigger problem for two main reasons (*see below*): 1) they extend farther to leeward, behind and on the windward hip of other boats, so they affect a wider area; and 2) there is more turbulence within each wind shadow, so it hurts speed and height more.

In light air a small amount of wind makes a huge difference in your performance. So losing even a knot or two of pressure (by being in a wind shadow) is much more of a problem than in heavy air. Being in bad air is similar to sailing in a lull on a puffy day: It's a lot slower and you wouldn't choose to do it.



A boat sailing in bad air will obviously not perform as well as a boat in clear air, either upwind or downwind. But the relative drop in performance is not linear over the range of wind velocities. In light air, sailing in a wind shadow is much more costly than it is in heavy air (where there may be very little cost at all).

### LIGHT AIR



### Why wind shadows are larger in light air

When the wind blows against a solid object like a boat's sailplan, it bends around that object, breaks into eddies and eventually returns to the way it was flowing before it was disturbed.

This turbulent flow (also called 'bad air') on the leeward side of every sailboat is called its 'wind shadow.' Since bad air is not good for performance, the key thing to know is how far that turbulent flow extends to leeward of a boat.

The answer depends a lot on wind velocity. In simple terms, the slower the air is travelling when it meets an object, the longer it will take to return to normal flow. In light air (left), therefore, a boat's wind shadow is relatively large (maybe 10 boatlengths long). But in heavy air (right), the wind has enough energy to re-establish flow relatively quickly (after maybe five lengths). That's one reason why you can feel the effects of bad air much farther away on light-air days.

These diagrams show a very approximate picture of air flow in wind shadows in light versus heavy air.

### HEAVY AIR





It's usually not a good idea to sail in bad air for very long, especially in light air. When there's not much wind, you need every bit of pressure possible, so it's critical to minimize time spent sailing in wind shadows.

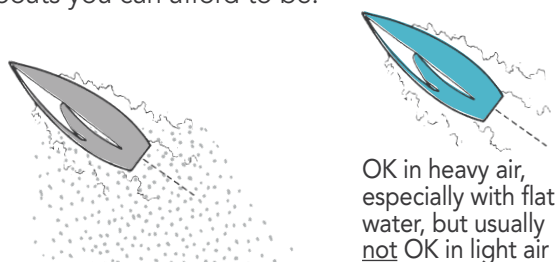
When it's windy, however, you are not as desperate to find extra pressure, and there is still quite a bit of wind in the shadows of other boats. So sailing in bad air is much more of a strategic option.

In this photo, for example, the closer boat is in the farther boat's wind shadow, but there's a lot of wind here so it won't hurt her very much. She can survive OK in this position to keep sailing on a lift, for example, or to head toward the right side of the course.

If the wind was light, though, the cost of staying in bad air would be too high for pursuing all but the most significant strategic options.

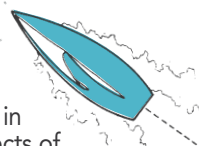
## Position yourself for clear air

The bigger your fleet, the harder it is to find clear air, both upwind and downwind. The key to good speed is putting yourself in positions where you can maintain clear air for long periods of time. And these positions depend a lot on the wind velocity. In light air, for example, you can't survive too close on another boat's windward hip or on the fringes of their wind shadow to leeward. The more wind you have and the flatter the water, the closer to other boats you can afford to be.

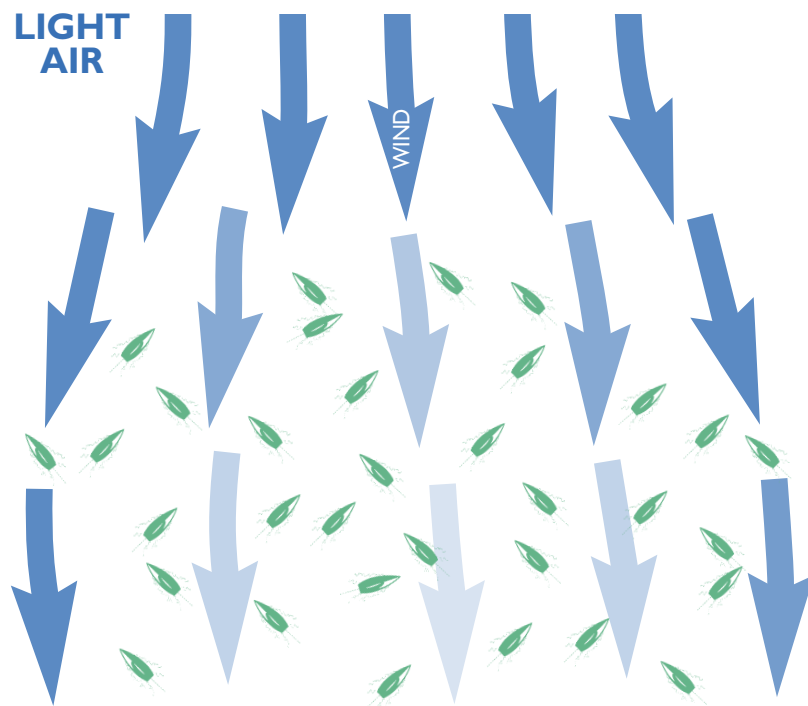


If the wind velocity is 6, a boat in bad air here might have only 4 knots of wind, which is a huge problem! But if the wind speed is 16, a boat in bad air with 14 knots won't lose nearly as much.

Being on the edges of a wind shadow is OK in heavy air, but in light air if you can feel any effects of bad air at all you are probably losing a lot.



## LIGHT AIR



## Watch for wind shadow effects from a big fleet

In light air, a large fleet of boats slows the wind like a snow fence. Often the wind doesn't have enough energy to maintain its strength through the middle of all the sails, so it tends to flow around or over the fleet as a whole. That's why you typically find more wind on the sides of the fleet and less in the middle.

In heavy air, this isn't such a problem. A slight snow fence effect does exist, but the wind has much more momentum and is able to fill more strongly and solidly around obstacles in its path. As a result, the middle of the course is a more viable strategic option than it is in lighter air.

## Boathandling maneuvers in light air vs. heavy air

One of the big differences between racing in light air versus heavy air is that it's usually a lot more difficult to execute good boathandling maneuvers when it's breezy. This is not surprising. More wind means boats go faster and bounce around a lot more (because there are usually bigger waves). More wind also creates a lot of noise and loads up the sheets we trim. Almost everything is more challenging in heavy air, so sailors need to focus on several things:

**Preparation** – You can often make a good jibe in

light air without much practice, but trying this in breeze is risky. So practice in wind and make sure all crew members understand their roles in maneuvers.

**Communication** – Talk more in heavy air because things happen quickly and you need to get the entire team on the same page. Talk louder because it's hard to hear over the noise of wind and waves.

**Anticipation** – Higher speeds in heavy air mean boats converge very quickly with other boats and marks. Keep looking ahead to avoid surprises.

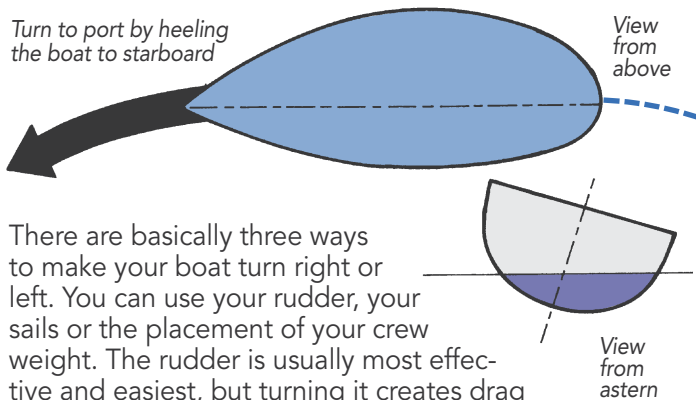
Wind strength	Distance Lost (boatlengths)	
	TACK	JIBE
Light	3	2
Medium	1.5	1
Heavy	2	1
Heavy (planing boats)	4+	3+

### Think before you tack or jibe

When you're considering a tack or jibe, think about whether the amount you'll gain strategically or tactically will be greater than the cost of the maneuver itself. Here is a very rough 'Distance Lost' chart (for a generic middle-sized boat) that shows several things. First, the cost of these maneuvers is least in moderate winds and greatest in light or heavy air. It might be worth tacking on a small header when you are racing in 10 knots of wind, for example, but not in 6 or 16 knots (unless your boat roll tacks really well).

Second, tacking and jibing are most costly for boats that are planing in heavy air like skiffs, cats and boats with asymmetrical chutes. When a boat has to come off a plane to change tacks, she loses a lot to boats that keep planing. For these boats, tacking or jibing is not worthwhile unless there's a very good reason.

### LIGHT AIR: Use crew weight for turning

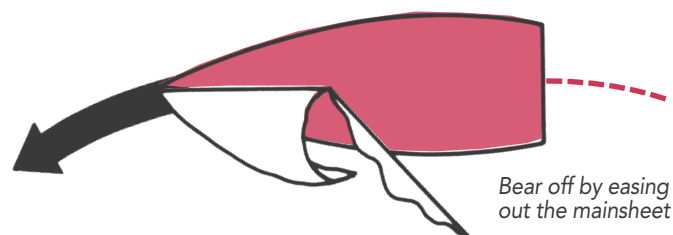


There are basically three ways to make your boat turn right or left. You can use your rudder, your sails or the placement of your crew weight. The rudder is usually most effective and easiest, but turning it creates drag and therefore is not good for speed, so you should use the other two methods as much as possible.

In light air, adjusting your sail trim is not an effective way to turn your boat because there's not enough wind pressure in the sails. But since the wind is not pushing too hard on the sails, it's easier to change the heel of the boat by moving crew weight from side to side. So when there's not much wind, focus on this technique (i.e. moving your weight to the starboard side to turn the boat to port, and vice versa).

This technique works especially well on smaller or lighter boats where crew weight is a significant part of the boat's overall displacement. Even on heavier keelboats moving your crew can help a lot in light air.

### HEAVY AIR: Use sail trim for turning



In heavy air, it's difficult to adjust the boat's heel angle by moving crew weight back and forth. With so much pressure in the sails, weight placement often has very little effect on turning. Therefore you have to rely on the trim of your sails (and your rudder).

Adjusting sail trim when it's breezy is not only helpful for turning the boat, it's essential! If you have ever tried bearing off around the first mark on a windy day without easing your mainsheet, you know how much effect the sails have on your ability to turn.

Basically, when you want to bear off, ease your main and trim your jib (see above). To head up, do exactly the opposite – trim the mainsheet and ease the jib.

When it's windy, trimming the sails makes the boat heel over a lot. This creates windward helm which is helpful when you want to head up. But if you're trying to bear off, you need to reduce helm by reducing heel. When you have a lot of breeze, you may actually need to ease the jib (as well as the main) to turn the boat.



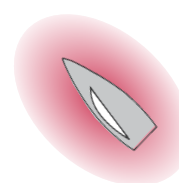


In light air, most racing is calm and orderly. But when it's windy, stuff happens that is unexpected. Boats broach, lose control, hit big waves and stop, lose steerage and so on. That's why in heavy air you need to keep several things in mind:

1. Give other boats a wider berth (more about the 'red zone' below).

2. Minimize maneuvers. Don't do too many maneuvers and don't be tricky or overly complicated for the skill level of your team; and

3. Leave time for maneuvers. In breeze everything happens at an accelerated pace, so start your boathandling moves early. Don't round the leeward mark with your spinnaker still half way up!



**'Red Zone'** – The area around another boat where there is a relatively high risk of hitting or fouling that boat (or both!).

## Beware of the 'Red Zone'

Getting close to other racing boats comes with a certain amount of risk. The closer you get, the greater the chance you will break a rule or have contact. And, obviously, both of those are things to avoid.

One way to handle this situation is by imagining a 'danger area,' or 'red zone,' around every other boat. Imagine that each boat is sailing in a protective bubble – if you enter into that space you're taking a risk that something bad may happen.

The size of this zone depends on several factors, but the most important of these is wind velocity. In light air the zone is fairly small. It's usually safe to get quite close to other boats because they are moving slowly and seas are likely calm, so there aren't any big surprises.

But in heavy air the red zone is much larger. That's because the boats are going faster (which means they converge more quickly), and there are often big waves. Sailors have less time to react, and the actions of each boat (bouncing around in the waves and wind) are less predictable. So you have to give them more space to be safe.

	LIGHT AIR	HEAVY AIR
Starting		
At Marks		
Crossings		

The three places where you're most likely to get very close to other boats are at the start, mark roundings and while crossing upwind. These are the times when you need to be especially aware of how big the 'red zone' is for the wind velocity (and wave condition) in which you are sailing.

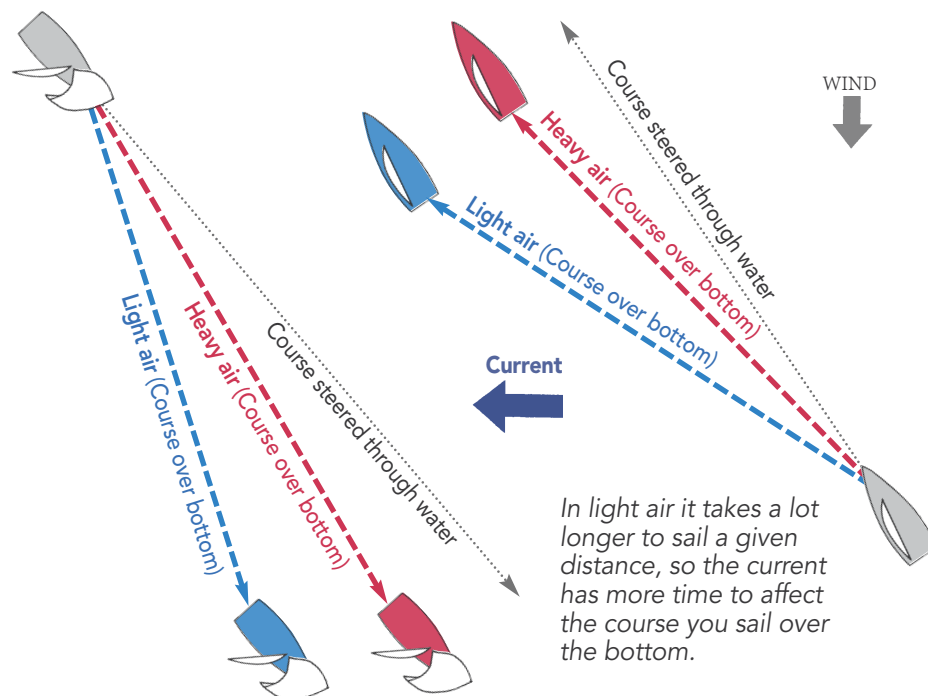
## The effect of wind speed on current, and vice versa

There are two important ways that current can impact your strategy. First, it moves your boat over the bottom, which means the course you make good is not the same as the course you steer. This affects laylines, rhumbelines and start/finish lines, as well as your strategy if the current is variable across the course. The lighter the wind, the greater these effects.

Second, the current changes your sailing wind. The velocity and direction of the wind you sail in are a product of the true wind and the wind caused by your movement due to current. Whenever the set or drift of the current changes, your wind will also change. This is much more noticeable in light air because the current speed is a larger fraction of the wind speed, so it has a correspondingly larger influence on your wind.

Rio de Janeiro, site of the 2016 Olympics, is known for its swirling local currents. In some course areas the water may literally be going in opposite directions only meters apart. This has a big effect on how boats travel over the bottom, of course, and it also influences the speed and direction of their sailing wind.

When racing in Rio, the primary strategic question is typically: 'Will this be a wind race or current race?' In other words, which factor will be more important during that race? This depends on how strong the current is running, obviously, but it also depends on the wind velocity. If the wind is light and the water flow is strong (see photo), the current is super important. But other times, like when you have heavy air and weak flow, the current may be insignificant. Consider this before, and during, every race.



### Current, wind velocity and course made good

Whenever there's current in your racing area, it affects the direction and speed of your movement over the bottom. Because of this it influences your motion relative to objects (such as marks) that are anchored to the bottom. And this makes a difference in your laylines, rhumbelines, mark roundings and start/finish lines.

A one-knot current, however, doesn't always have the same effect – it depends on wind velocity. In light air, current has a relatively large impact on your course over the bottom. If your speed through the water is only three knots, the current is one third of your speed. For every 300 meters you sail, the current will push you 100 meters in the direction it is flowing.

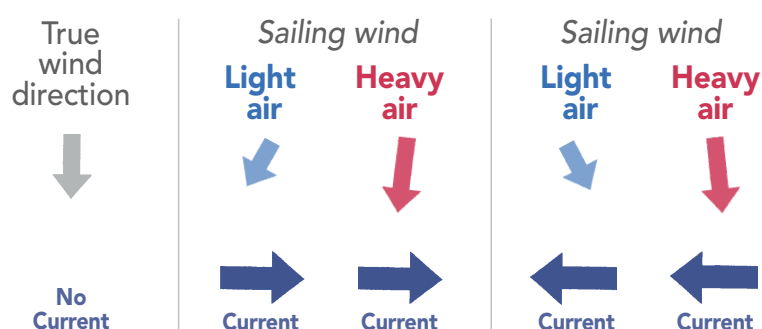
In heavy air, however, current has less influence. If your boatspeed is six knots and you sail 300 meters, a one-knot current will push you only 50 meters. That's a big difference! Basically, the lighter the wind, the more the current will affect how you need to maneuver around marks.



## How current affects your wind direction

The 'sailing wind' is the wind in which you sail. It's the breeze you feel when you are sitting in your boat with your sails down, floating in the racing area. The sailing wind is a combination of the true wind (felt by a person on shore or on an anchored RC boat) and the wind created by movement of the water (current). If the current changes in either strength or direction, this affects the velocity and direction of your sailing wind.

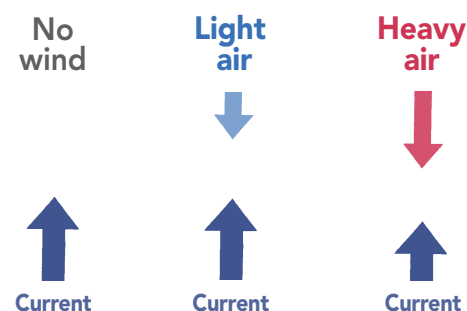
When there is no current, a boat's sailing wind will be the same as the true wind (*below left*). But as soon as the current starts, her sailing wind changes. How much it changes depends on current strength and wind velocity. In light air, the current can have a big influence on the strength and direction of your sailing wind. But in heavy air it won't matter so much. The lighter the wind and the stronger the current, the bigger the changes you should expect to see in your sailing wind.



## How wind velocity affects the current

We've discussed how the current can have a big effect on the wind in which you race, but the opposite is also true. The friction caused when the wind blows over water can slow or speed up current flow, sometimes a lot.

Consider the situation below where the wind and current are moving in opposite directions. If the wind is light, it won't affect the current much at all. But if the wind blows hard it will slow the water movement; in fact, if the wind stays strong for a long enough time it might actually make the water flow stop or go in the other direction. When you are sailing in current with strong breeze, expect the wind to have some effect on water movement.



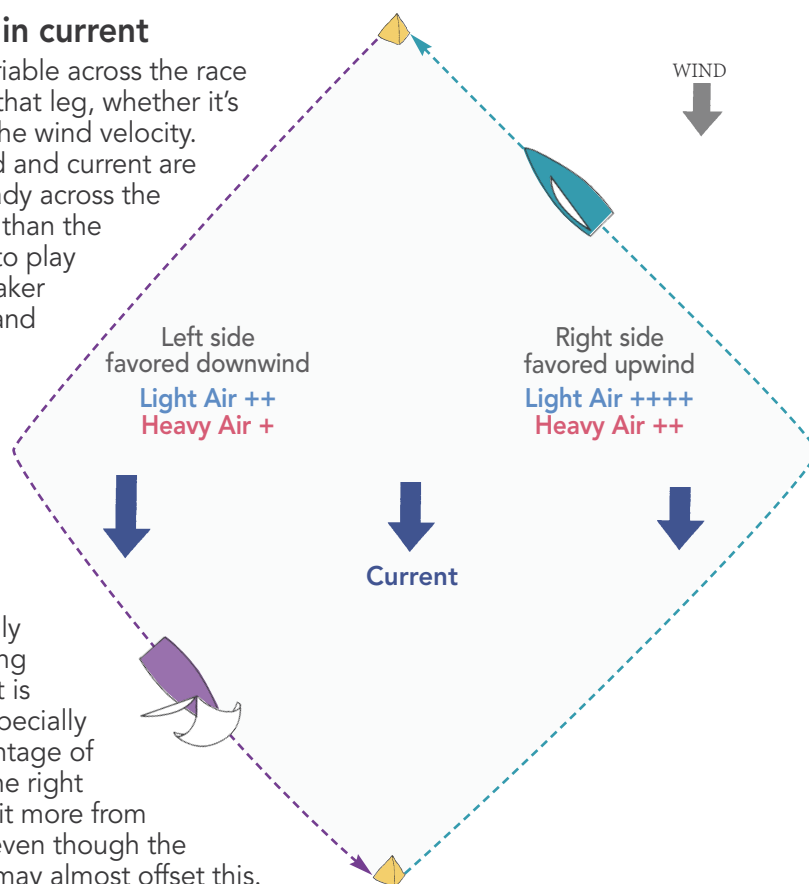
## The effect of wind velocity on strategy in current

When the velocity or direction of the current is variable across the race course, this will definitely be a strategic factor on that leg, whether it's a beat or run. How much of a factor depends on the wind velocity.

Imagine a race course as shown here. The wind and current are both going in the same direction. The wind is steady across the course, but the current is stronger on the left side than the right. When boats are sailing upwind, it's favored to play the right side for two reasons: 1) the current is weaker there so it doesn't push boats to leeward as fast; and 2) the sailing wind will be stronger on that side because there is less current going with the wind.

The right will be better in any wind velocity, but it is *much more favored in light air*. That is because: 1) when a boat is going slowly the current has a greater effect; and 2) a little extra sailing wind is much more valuable when there is less wind to begin with.

Now consider boats going downwind. As expected, the left side (looking upwind) is generally better because the current is stronger there pushing boats to leeward. But it's not favored as much as it is upwind because: 1) boats go faster downwind (especially in heavy air) so current strength is a smaller percentage of boatspeed; and 2) there is more sailing wind on the right side. We know that boats sailing downwind benefit more from increased pressure than boats going upwind. So even though the current is better on the left, the better wind right may almost offset this.





## Boatspeed – the *big* difference between light and heavy air!

**W**hen comparing strategies for light and heavy air, the biggest and most obvious difference involves everything related to boatspeed. Sail trim, rig tuning, helm, weight placement and boat set-up all vary greatly across the spectrum of wind velocity.

Unlike certain strategies and tactics, which often work for any wind velocity, almost all speed-related

controls need to be changed a lot from light air to heavy air. The lists below give a simple example of how this applies to sail trim.

No matter how much wind you have, one key to to success always applies – the need to keep ‘shifting gears’ when conditions change. So look continuously for puffs and lulls relative to your average wind speed.

### LIGHT AIR – Sail shape and trim

In light air most boats are looking for more power and helm, so those are the primary sail-trimming goals. As a general rule, power comes from deeper sail shapes, so in light air you normally use your sail controls to make your sails fuller:

**Backstay** – Loose; just tight enough to keep the rig from bouncing around

**Boom vang** – No tension, just take up the slack

**Traveler** – Pull it to windward so the boom is on or slightly above centerline

**Outhaul** – Eased to add fullness in lower sail

**Cunningham** – No tension because that would make the sail flatter; look for ‘speed wrinkles’

**Sheets** – Eased from maximum trim to add twist and promote speed rather than pointing

**Jib leads** – Move forward to add power

**Tuning** – Increase rake to get more helm and feel; loosen rig settings to add power; use pre-bend to get proper main shape without a tight backstay

### HEAVY AIR – Sail shape and trim

In heavy air most boats have plenty of power, so the primary sail-trimming goals are to keep the boat under control, make it easy to sail and avoid too much heeling or windward helm. This means using the sail controls to achieve flatter sail shapes:

**Backstay** – Very tight, but not so tight that the main has too many overbend wrinkles or inverted shape

**Boom vang** – Lots of tension especially on boats that use ‘vang sheeting’ upwind

**Traveler** – Drop it so the boom is on centerline or lower if needed to relieve windward helm

**Outhaul** – Very tight so sail is flat along boom

**Cunningham** – Tight to make sail flatter and pull draft forward (because bending mast moves it aft)

**Sheets** – Tighter than light air, but eased if needed to power through waves and reduce helm

**Jib leads** – Move aft to add twist and depower

**Tuning** – Reduce rake to get less helm (except on boats that can move the centerboard aft); use tight rig settings; keep the mast from over-bending

#### Light Air



In light air, ease your sail controls to give the sails a full, powerful shape. ‘Speed wrinkles’ along mast show luff tension eased to add depth.

#### Heavy Air



In heavy air, pull your sail controls tight to give the sails a flat, low-drag shape. Note ‘overbend wrinkles’ stretching from the mast into the middle of the sail. These indicate the sail has reached its maximum flatness, so the mast should not be bent much more.

Photos courtesy North Sails OD

## Manage your helm in light and heavy winds

One of the key variables in boatspeed is the amount of 'helm' you have. Helm is a function of how far you must turn the rudder in order to keep the boat going straight. If you have to hold the rudder  $2^\circ$  to windward of centerline, then you have  $2^\circ$  of windward helm.

Most boats go fastest upwind with about  $3^\circ$  to  $5^\circ$  of windward helm. This makes it easier to stay in the groove and helps the boat point higher naturally. When the wind is light, however, it's often hard to get enough helm to realize these benefits. If the helmsperson doesn't have much feel (less than  $2^\circ$  or  $3^\circ$  of helm), take steps to increase it (see right).

When it's windy, boats often develop too much windward helm. If you have more than about  $5^\circ$  or  $6^\circ$ , the boat will have a strong tendency to head up toward the wind, and you will need to pull hard on the rudder to keep going straight. At a certain point, the increased drag outweighs the benefits of a moderate helm, and you will start going slower. This is when you should take steps to reduce helm (see right).



JH Peterson photo

### LIGHT AIR

Increase windward helm by doing some or all of these:

- Move crew weight forward
- Let the boat heel more
- Avoid pinching; foot more
- Rake the mast farther aft
- Sail with less rig tension
- Make your sails (especially the main) fuller by easing outhaul, backstay and cunningham
- Pull the traveler to windward
- Move the centerboard forward
- Trim your mainsheet a little harder (but don't let it stall)

### HEAVY AIR

Decrease windward helm by doing some or all of these:

- Move crew weight aft
- Hike harder to flatten the boat
- Pinch slightly to sail flatter
- Rake the mast farther forward
- Sail with more rig tension
- Make your sails (especially the main) flatter by tensioning outhaul, backstay and cunningham
- Ease the mainsheet
- Drop the traveler to leeward
- Move the centerboard aft

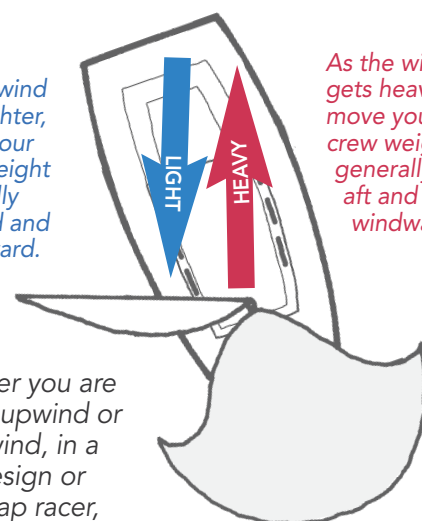
## Position your weight according to the wind velocity

The wind velocity has a big influence on the ideal location of crew weight during beats and runs. In most cases you should move to windward when it's windy and to leeward when it's light. This is largely a matter of controlling heel angle and therefore helm (see above). If the boat is too flat in light air, you won't have much helm at all and it will be hard to stay in the groove. That's a good reason to move weight to leeward. If the boat heels too much in breeze you'll have too much helm and rudder drag. That's why you move to windward and hike!

Similar reasoning applies to fore-and-aft weight placement. Moving crew weight forward puts more of the boat's rounded bow section in the water and raises some of the flatter stern out of the water. This is good in light air because it increases windward helm and reduces wetted surface. But in heavy air it makes the bow plow. When it's windy, moving aft reduces helm and allows the boat to sail fast on its flatter stern sections.

Moving crew around for different wind velocities is obviously important for small, lightweight boats that are affected most by weight placement, but it will make a difference on any size boat.

As the wind gets lighter, move your crew weight generally forward and to leeward.



As the wind gets heavier, move your crew weight generally aft and to windward.

Whether you are sailing upwind or downwind, in a one-design or handicap racer, you should generally move your weight as shown here. In puffy conditions, keep moving constantly to 'change gears.'



## How the wind speed affects your laylines

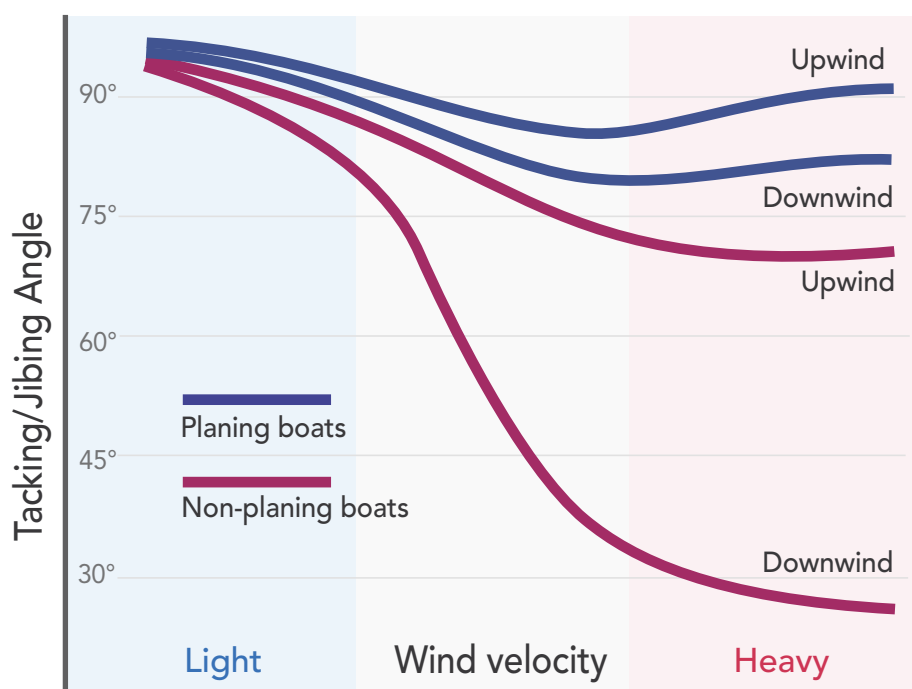
Laylines are critical for success in sailboat racing. Even if you are smart enough to avoid getting to a layline too early, you still have to be on the layline sooner or later in order to round the windward or leeward mark. And since the final approach to the mark is often very crowded, your layline call can be extremely important.

One thing we can say for sure is that laylines are not fixed in one place on the race course. Current, wind shifts, waves and the type of boat you're racing all affect layline location. But wind velocity may be the most important variable of all, especially when racing downwind.

JH Peterson photo



In heavy air, laylines are affected by leeway (sideways drift of the boat to leeward of the course steered) caused by heel angle, wind pressure and wave motion. In light air leeway isn't a problem, but laylines are influenced by most boats' wider tacking angles and by the costly effects of bad air.

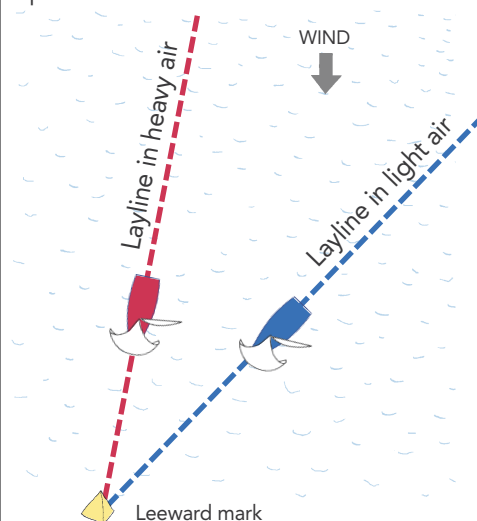


This is a very rough chart of the tacking and jibing angles that boats might experience over a range of wind velocities. A general rule of thumb is that as the wind velocity increases, a boat's tacking and jibing angles become narrower, sometimes quite a bit narrower. This means that laylines, both upwind and downwind, can change a lot due to wind velocity, especially in the lighter wind ranges (see right).

Of course, jibing and tacking angles also depend on boat type. As you can see above, the angles change a lot more for non-planing (displacement) boats than for planing boats. So sailors racing heavier, slower boats will see the most significant change in laylines, especially downwind.

### Watch for moving laylines

In certain conditions, wind velocity can have a huge impact on laylines (and therefore on your strategy and tactics). Here's a displacement-type boat racing downwind toward the leeward mark. In light air she has to sail high angles to maintain speed, so her layline to the mark is shown by the blue line. But in heavy air she can sail a much lower angle – that layline is red. There's a huge variation here, so knowing your angles across the range of wind velocity is obviously helpful in planning your optimal track to the mark.





## Use checklists for light and heavy wind

It's hard to remember all the things you should be thinking about in different wind velocities, so why not keep a reminder list? Many sailors do this, even at the highest levels. Make a list of key points and priorities for light air and heavy air, and keep this on your boat or in the pocket of your PFD. Then review it the night before a regatta, on your way out to the starting line, or in between races (especially if the conditions change).

Below are some possible reminders you might include on your list. Of course, the goal is to create a tool that is valuable for your particular boat and team, so modify these lists accordingly. For example, you could add tuning and trim numbers that are specific to your boat, or reminders for your crew about priorities in particular maneuvers. Once you have a rough draft of your list, start using it and keep working to improve it.



### Light Air – Reminders

- ☐ Avoid making too many maneuvers
- ☐ Make maneuvers when you are going fast
- ☐ It's better to perform maneuvers smoothly than quickly
- ☐ Use crew weight aggressively to help turning
- ☐ Keep your crew weight forward
- ☐ Avoid bad air at almost any cost
- ☐ Try not to sail near packs of boats
- ☐ Err on the side of going too fast, not too slow
- ☐ Don't worry about pointing until you are fast
- ☐ Find better pressure! This is often more valuable than getting a shift
- ☐ It's hard to survive upwind in a position close to windward of another boat
- ☐ Get rid of extra weight and stuff before racing
- ☐ Be careful of getting far away from the start
- ☐ In a large fleet, beware of less wind velocity in the middle of windward legs
- ☐ Avoid waves as much as possible
- ☐ Current may have a large effect on your wind and course over the bottom (e.g. laylines)
- ☐ Sail upwind with your boom on or slightly above centerline
- ☐ If boatspeed is not good, ease sheets a little
- ☐ Avoid unneeded movement of rudder or crew

### Heavy Air – Reminders

- ☐ Avoid making too many maneuvers
- ☐ Maneuver (e.g. jibe) when you are going fast
- ☐ In very heavy air, maneuver during lulls
- ☐ Make maneuvers quickly and confidently
- ☐ Ease vang for big maneuvers
- ☐ Move your crew weight aft
- ☐ Hike! Get your crew weight far to windward
- ☐ Start maneuvers early (e.g. takedowns)
- ☐ Use sail trim aggressively to help turning
- ☐ Play the shifts! These may be more valuable than finding additional pressure
- ☐ Set up tuning and trim to keep windward helm manageable
- ☐ Use loud voices to communicate
- ☐ Give other boats a wider berth to prevent contact and fouling (avoid 'red zone')
- ☐ Bad air doesn't hurt as much as in light wind
- ☐ Keep the rudder still, straight through waves
- ☐ Wear the right clothing to keep you warm, safe and comfortable
- ☐ Consider moving the centerboard aft
- ☐ Keep a good lookout because boats are converging at rapid speeds
- ☐ Work hard to surf or plane downwind
- ☐ Check gear to prevent breakdowns

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## COMPARISON: Light Air vs. Heavy Air

## Tactics

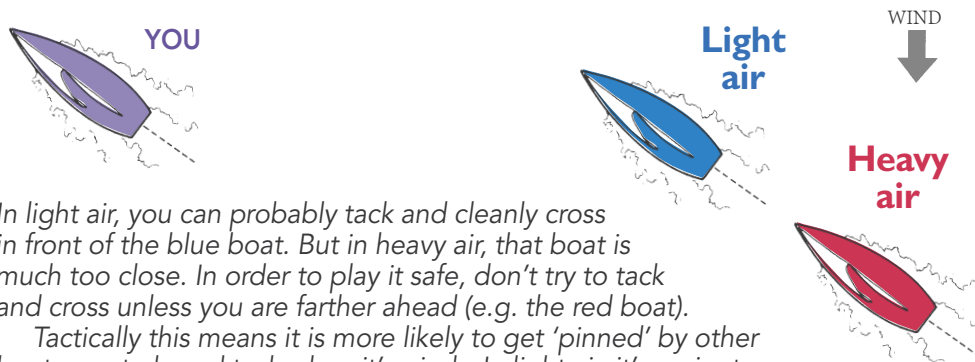
# Adjust your tactics for the wind velocity

Tactics are the boat-on-boat moves you make to follow your strategic plan amidst a fleet of competing boats. Since these moves normally take place in close proximity to other boats, you have to make them with a bit of caution. In heavy air, for example, there's a relatively high risk of hitting or fouling nearby boats if you get very close (*see discussion of the 'red zone' on page 9*). And in light wind, getting too close to other boats can easily put you in their bad air. Here are two other tactical situations affected by wind velocity.

### Can you tack and cross?

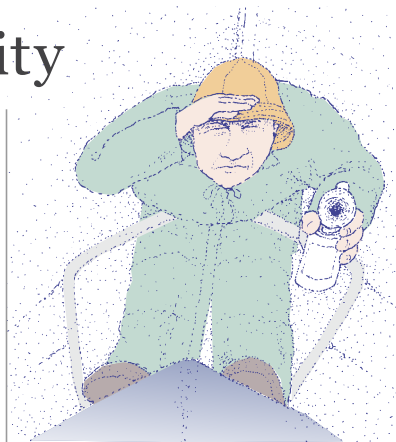
The ability to tack and cross in front of a boat on your windward hip can be critical when your strategy says go the other way (e.g. when you get headed). This is especially true when you're on starboard tack (e.g. coming off the start line) because after tacking you will be on port tack without the right of way.

It's not easy to know how much room you need to make a successful tack in this situation. It depends on your team's tacking ability, of course, but also on the wind velocity. In heavy air, for example, tacking is a relatively difficult maneuver. It slows you down a lot while the boat on your hip is still sailing at full speed in the breeze. As a result, you need a lot of room to make sure you can cross cleanly. In light air, tacking is costly as well, but at least the other boat is not moving nearly as fast. That means you don't need to be as far ahead of a boat on your hip in order to be able to tack and cross them.



In light air, you can probably tack and cleanly cross in front of the blue boat. But in heavy air, that boat is much too close. In order to play it safe, don't try to tack and cross unless you are farther ahead (e.g. the red boat).

Tactically this means it is more likely to get 'pinned' by other boats on starboard tack when it's windy. In light air, it's easier to cross or duck behind another boat. But these options are tougher in breeze. So be careful about positioning yourself to leeward and ahead on starboard tack.



### Keep a good lookout!

When it comes to tactics, keeping your head out of the boat is always important. It's key to watch the situations that develop as you converge with other boats so you have time to plan your next move.

But this is especially key in heavy air, for several reasons:

- Boats go faster in breeze and therefore converge with each other much more quickly. You can't afford to sail 'blind' for very long.
- With the crew hiking and the boat sailing with extra leeward heel in breeze, it's harder to see and keep track of other boats, so you have to work harder at this.
- In heavy air there's a bigger 'danger zone' around other boats (*see page 9*). Keep a lookout to stay farther away.